

A FUNCTIONAL COVER FOR USE WITH A WIRELESS TERMINAL.Background of the Invention

5 The invention relates to a functional cover for use with a wireless terminal, such as a cellular phone. Such covers include functionality that is implemented by adding electronics to the cover. The invention furthermore relates to the mechanical and the electrical interface between a functional  
10 cover and a wireless terminal.

Summary of the Invention

According to a first aspect of the invention a method is provided for operating an electric circuitry included in an exchangeable cover part for supporting a user interface of said wireless terminal. The wireless communication terminal and said user exchangeable cover part are electrically interconnected by means of an electrical connector having connector pins, and the method includes identification of the type of said user exchangeable cover part, and operating at least one of the connector pins in an identification state for sensing a value included in the identification means, and afterwards in an operation state for operating the electric circuitry of the user exchangeable cover part. Hereby the wireless terminal is able to identify the type of the cover in a booting routine and afterwards to operate the cover according to this. The cover may have special illumination effect, special game keys, special sound keys, special memories for playing music or playing games.  
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Preferably the connector has a plurality of pins, and at least one of said connector pins is operated in an identification state for sensing a resistor value included in the identification means, and afterwards in an operation state for operating the electric circuitry of said user exchangeable cover part.

According to a preferred embodiment of the invention, the operation state is a frequency mode for directing an electrical representation of a ringing signal to the electric circuitry for providing an illumination effect following the ringing signal.

According to a further aspect, the invention relates to a wireless communication terminal having a user exchangeable cover part, wherein the wireless communication terminal and the user exchangeable cover part are electrically interconnected by means of an electrical connector. The user exchangeable cover part comprises identification means, and an electric circuitry for supporting a user interface of the wireless terminal. The wireless terminal identifies the user exchangeable cover part by detecting the identification means; and the connector includes a plurality of connector pins, where at least one of the connector pins is operated in an identification state for sensing a value included in the identification means, and afterwards in an operation state for operating the electric circuitry of the user exchangeable cover part.

Preferably, the connector includes a plurality of connector pins arranged in line in an equal distance. Advantageously, the connector pins are arranged at the rear side of the cover part. According to a preferred embodiment of the invention the number

of connector pins is three. According to a further embodiment of the invention the number of connector pins is five.

Preferably, at least one of said connector pins is operated in an identification state for sensing a resistor value included in the identification means, and afterwards in an operation state for operating the electric circuitry of said user exchangeable cover part.

10 In one implementation of the invention, the operation state is a frequency mode for directing an electrical representation of a ringing signal to the electric circuitry for providing an illumination effect synchronised with the ringing signal.

15 In a further aspect of the present invention the user exchangeable cover part may comprise one or more keys adapted to play at least one sound, the one or more keys being connected to the electric circuitry of the user exchangeable cover. The one or more keys may be mapped to a set of tones and/or sound effects, which set of tones and/or sound effects may comprise Music Instrument Digital Interface (MIDI) tones (). The keys may be adapted for sound creating purposes, which may comprise music composing applications, sound creating applications, gaming, ring tone creation, system sound creation, sending sounds with Multimedia Messaging Service (MMS) or other messaging services, or any combination thereof.

According to a further aspect of the invention a user exchangeable cover is provided for releasable attachment to a wireless communication terminal, the user exchangeable cover has an electrical connector part for being electrically connected to the wireless communication terminal in attached position. The user exchangeable cover comprises identification

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means, and an electric circuitry for supporting a user interface of the wireless terminal. The connector part includes a plurality of connector holes, where at least one of said connector holes is adapted to allow the wireless terminal to 5 operate the user exchangeable cover in an identification state for sensing a value included in the identification means, and afterwards in an operation state for operating the electric circuitry of said user exchangeable cover part.

10 The user exchangeable cover part may comprise one or more keys adapted to play at least one sound, the one or more keys being connected to the electric circuitry. The one or more keys may be mapped to a set of tones and/or sound effects, which set of tones and/or sound effects may comprise MIDI-tones. The keys 15 may be adapted for sound creating purposes, which may comprise music composing applications, sound creating applications, gaming, ring tone creation, system sound creation, sending sounds with MMS or other messaging services, or any combination thereof.

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#### Brief Description of the Drawings

For a better understanding of the present invention and to understand how the same may be brought into effect reference will 25 now be made, by way of example only, to the accompanying drawings, in which: -

Fig. 1 schematically illustrates a preferred embodiment of a wireless telephone according to the invention.

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Fig. 2 schematically illustrates a functional front cover for the wireless telephone shown in fig. 1.

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Fig. 3 schematically shows the essential parts of a wireless telephone for communication with e.g. a cellular network.

Fig. 4 shows electrical connection between the main block of a wireless telephone and a functional front cover according to preferred embodiments of the invention.

Fig. 5 shows the connection pad for connecting the wireless telephone and a functional front cover according to the preferred embodiment of the invention.

Fig. 6 shows the preferred embodiment for the connector part mounted in the functional cover according to the preferred embodiment of the invention.

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Fig. 7 shows schematically in partial cross section the connector part connecting the main block of a wireless telephone and a functional front cover according to the preferred embodiments of the invention.

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Fig. 8 shows a flow chart illustrating the booting and mode selection procedure according to the preferred embodiment of the invention.

25 Detailed Description of the invention

Fig. 1 shows a preferred embodiment of a wireless terminal, such as a cellular phone 1, which comprises a user interface having a keypad 2, a display 3, an on/off button 4, a speaker 5 (only openings are shown), and a microphone 6 (only openings are shown).

According to the preferred embodiment of the invention the keypad 2 has a first group 7 of keys as alphanumeric keys, two

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soft keys 8, and a scroll-key 10 (up/down) for moving a cursor in the display. Furthermore the keypad includes two call-handling keys 9 for initiating and terminating calls. The present functionality of the soft keys 8 is shown in a separate field in the bottom of the display 3 just above the soft keys 8.

The cellular phone 1 has an exchangeable functional front cover 25. An exchangeable front cover is intended to be changed by the user himself without use of tools. Such an exchangeable front cover is disclosed in US 09/503595 filed by the applicant, and this disclosure is hereby incorporated by reference. Fig. 2 shows the exchangeable functional front cover 25 according to the invention.

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Fig. 2 schematically shows the most important parts of a preferred embodiment of the phone, said parts being essential to the understanding of the invention. A processor 18, which supports the GSM terminal software, also controls the communication with the network via the transmitter/receiver circuit 19 and an antenna 20.

The microphone 6 transforms the user's speech into analogue signals; the signals formed thereby are A/D converted in an A/D converter (not shown) before the speech is encoded in an audio part 14. The encoded speech signal is transferred to the processor 18. The processor 18 also forms the interface to a RAM memory 17a and a Flash ROM memory 17b, a SIM card 16, the display 3 and the keypad 2 (as well as data, power supply, etc.). The audio part 14 speech decodes the signal, which is transferred from the processor 18 to the earpiece 5 via a D/A converter (not shown).

Furthermore a clock generator 24 supplies a clock signal to the processor 18. The processor 18 is via a three or five wire bus and a connector 41, 42, 44 connected to electronics 46 in the functional cover 25.

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A functional cover 25 is a cover for a wireless terminal 1, which includes functionality that is implemented by adding electronics 46 to the cover 25. To give some examples, it may include an application reacting e.g. to the power supply or 10 ringing tone. It can also be an application that provides input to the phone (e.g. touch pad).

The interface between the functional cover and the phone will be described. Five different modes will be introduced, out of 15 which three are very simple and can be used for e.g. sensor applications. The remaining two modes are the generic asynchronous serial bus and a mode based on a synchronous data protocol.

20 The objective of the invention is not to provide a full specification of all the different operation modes, but to allow functional covers and transceivers to interact, even through all the modes are not supported by both parts.

25 According to the preferred embodiment of the invention the connector includes three connector pins, a positive power supply voltage pin ( $V_{DD}$ ), a negative power supply voltage pin ( $V_{SS}$ ), and a Cover Type Indicator pin (CTI).

30 Preferably the CTI-pin (Cover Type Indicator) is a bi-directional and bi-mode (analogue/digital) signal pin. The CTI-pin is used for a frequency mode, a PWM-mode and a CTI-mode.

According to an alternative embodiment of the invention the connector includes five connector pins. As for the first embodiment, the connector includes a positive power supply voltage pin ( $V_{DD}$ ), a negative power supply voltage pin ( $V_{SS}$ ), and a Cover Type Indicator pin (CTI). Furthermore the connector includes a Data Signal pin and a Clock Signal pin.

The Data Signal pin is used for asynchronous data in data mode and in a synchronous data mode. The protocol for the synchronous data mode may be according to the I2C-Bus Specification, version 2.1, January 2000. The Clock Signal pin is used for the clock in synchronous data mode.

Pin	Output type	Description	Communication direction
$V_{DD}$		Power supply	Transceiver to Functional cover
$V_{SS}$		Ground	Transceiver to Functional cover
CTI	Analogue	Frequency output	Transceiver to Functional cover
	Digital	PWM output	Transceiver to Functional cover
	Analogue	Cover Type Indicator	Functional cover to Transceiver
	Digital	PWM input	Functional cover to Transceiver
Data	Digital	Asynchronous data output	Transceiver to Functional cover
	Digital	Synchronous data output	Transceiver to Functional cover
	Digital	Asynchronous data- input.	Functional cover to Transceiver
	Digital	Synchronous data input	Functional cover to Transceiver
Clock	Digital	Clock output	Transceiver to Functional cover
	Digital	Clock input	Functional cover to Transceiver

15 Table 1 Functional cover interface pins

According to the invention, a baseband engine and a functional cover do not have to support all the modes. This means that the

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physical interface may comprise from three to five pins depending on the number of supported modes.

If the BB engine supports multiple modes, passive mode is not  
5 allowed to affect the active mode. This means for example, when  
making the CTI measurement, other pins driving the CTI-pin must  
have high impedance. Furthermore the baseband engine must be  
able to drive  $R_{CTI}$ .

10 When the wireless terminal 1 is switched on, or the processor  
18 detects that a new functional cover has been attached to the  
transceiver part, a boot sequence is initiated. During the  
boot, the type of the cover is detected via the CTI signal. Ac-  
cording to that information, the corresponding data mode is se-  
15 lected and the appropriate power supply level,  $V_{dd}$ , is sup-  
plied. An example of the boot sequence and mode determination  
process is presented in fig. 8.

First the power is switched on to the phone in step 100. Then  
20 the size of the CTI-resistor,  $R_{CTI}$ , is measured in step 101. If  
the resistor measurement result, in step 102 does not exceed a  
predetermined value (e.g. 750 kOhm), the functional cover is  
deemed to be attached and a further investigation in order to  
identify the cover, has to be done. If the resistor measurement  
25 result in step 102 exceeds the first predetermined value, the  
functional cover is deemed to be present. The booting in step  
103 has to be continued under the presumption that the cover  
does not support the electric interface according to the inven-  
tion.

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If the processor 18 in step 104 identifies that the cover is  
"intelligent", this means that the cover 25 has an asynchronous  
or synchronous data interface, further information will be ex-

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changed via the digital interface in step 105. The digital interface and the power scheme have to be defined. Hereafter the booting will be continued in step 106.

- 5 If the cover in step 104 is deemed not to be "intelligent", the CTI-resistor,  $R_{CTI}$ , is compared with a second threshold (e.g. 64,9 kOhm) and a third threshold (e.g. 93,1 kOhm), the cover 25, is deemed to have passive components only, and these components are powered by the power supply of the wireless terminal
- 10 1. The voltage is determined by the processor 18 in step 108 by means of a look-up table. The booting is continued in step 109.

If the CTI-resistor,  $R_{CTI}$ , falls outside the interval defined by the second and the third threshold, the cover 25 is deemed to be able to perform other modes as a pulse mode, a PWM mode or a frequency mode. The mode and power scheme are determined by the processor 18 in step 110 by means of a look-up table. The booting is continued in step 111.

Mode	$R_{CTI}$ value
Synchronous data mode	2.00 kOhm
Asynchronous data mode	6.65 kOhm
PWM data mode	30.90 kOhm
	45.30 kOhm
	64.90 kOhm
CTI data mode	93.10 kOhm
	137.0 kOhm
Freq. data mode	210.0 kOhm
	357.0 kOhm
	750.0 kOhm
NO COVER	$\infty$

Table 2 mode supported in dependence of the impedance  $R_{CTI}$ .

Table 2 above describes the CTI resistor value  $R_{CTI}$  vs. functionality conversion. The whole conversion range is preferably divided into a predetermined number of different sub-ranges.

- 5 For the "intelligent" modes (synchronous and asynchronous), only one resistor value has been reserved, since all the needed additional information can be transferred via the interface. For PWM- and CTI-modes, two resistor values are reserved and for the Frequency-mode, four resistor values have been reserved.
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The power control scheme is based on the CTI-information, which is defined in the table 2. The electrical parameters of the power supply include the power supply voltage VDD, the output current IDD. The output impedance ZOUT of the wireless terminal 15 is 1, and the power on time and power off time.

#### Data interface Synchronous mode (Data and Clock pins)

- 20 The data specification used according to the invention may be a sub set of I2C-bus specification version 2.1, January 2000, by Philips Semiconductors. In the synchronous data mode the data pin is used for transferring data between the wireless terminal 1 and the functional cover 25, usually under control of the processor 18 and the clock oscillator 24 associated therewith.
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#### Data interface asynchronous mode (Data pin)

- 30 Data is transferred in the asynchronous data mode based on an asynchronous half-duplex signal. The power supply may be in the level of  $V_{DD} = 2,7V$  with a data rate of up to 230 kbps.

The asynchronous data mode as well as the synchronous data mode may be used for loading data from multi-media memory card (MMC) like memories included in the functional cover 25 into the

5 wireless terminal for being handled by means of the processor

18. Such a data connection may be used for loading data from multi-media memory card (MMC), like memories included in the functional cover 25, into the wireless terminal for being han-

dled by means of the processor 18. These data may include, e.g.

10 MP3 music files and executable games. Hereby it has become pos-

sible to provide a gaming cover, perhaps having an extra joy-

stick, whose operation is sensed by the gaming cover and trans-

ferrered to the wireless terminal via the data pin. The game may

also be run on an extra processor included in the functional

15 cover 25, but using the display 3 of the wireless terminal 1.

Extra UI units as a touch sensitive pad/screen or an extra dis-

play may be provided on the functional cover 25 and controlled

by the processor 18.

20 Alternatively, the functional cover 25 is adapted for a music composer application or any sound creating application designating keys to be assigned to tones and/or sound effects. A de-

fault mapping between the keys and a set of tones and/or sound

effects is provided. However, a user is enabled to select a

25 number of tones and/or sound effects, and to map these tones and/or sound effects to the keys. Repeated tone, fading tone or

any other sound may be mapped to e.g. pressing a key for a par-

ticular long period of time or pressing a key together with a

shift key. The tones and/or sound effects comprise sounds pro-

30 vided by the wireless terminal 1, and/or MIDI-tones.

The MIDI protocol is an entire music description language in binary form. Each word describing an action of musical perform-

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ance is assigned a specific binary code. The protocol also includes percussion oriented actions. To sound a note in MIDI language a "Note On" message is sent, and then a note "velocity" is assigned, which determines how loud the note is played.

5 Other MIDI messages include selecting which instrument to play, mixing and panning sounds, and controlling various aspects of electronic musical instruments. Normally, a wave table comprising available sounds is used for sound creation according to the MIDI music description. While MIDI is musical performance  
10 information, the term MIDI-tones is here the audio output from the entire MIDI system.

Further, the functional cover 25 comprises memory and processing capabilities so as to provide an ability to create sounds.

15 The memory may comprise wave tables, sound clips, or any other sound information required by said music composer application or sound creating application. Processing capabilities are needed for audio processing. Processing capabilities and memory may be located in the functional cover 25, in the wireless terminal 1, or any combination thereof.  
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The sound creating capabilities are used for music composing applications, sound creating applications, gaming, ring tone creation, system sound creation, sending sounds with MMS (Multi media Messaging Service) or other messaging service, or any combination thereof.

PWM data mode (via CTI-pin)

30 Data is transferred using bi-directional CMOS level PWM-modulated CTI-signal. The power supply may be in the level of  $V_{DD} = 2,7V$ . The pulse signal may have a variable frequency up to 32 kHz. The pulse duty cycle may be varied between 0,01 and

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1. This is an analogue signal in digital format, whereby a sound can easily be transferred ref. buzzer signal.

CTI data mode (via CTI-pin)

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The type information of the cover is given in the CTI. I.e. the processor 18 detects the value of the pull down resistor during the start-up (boot) of the phone and selects the right data and power interface mode according to the predefined table.

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This mode is very applicable for applications that do not need any stimulus from the wireless terminal. A flashlight is a good example of such an application.

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Frequency mode (via CTI-pin)

In the frequency mode, the functional cover 25 is controlled with the frequency of the CTI-signal. Amplitude information is not needed. Therefore the driving signal can be a small analogue voltage, which is then amplified in the cover end. The frequency signal may according to the preferred embodiment be variable up to 10 kHz.

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This mode can be used to direct a ringing tone to the functional cover 25. Once there, it can be used as a stimulus, for example driving a "light organ".

30 The connector interface may comprise three to five pins and associated pads. The electrical requirements for different signal pins will probably be quite different. The CTI-pin will be used for low, whereas clock and data will be used for medium bandwidth communication. For high bandwidth communication

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something more sophisticated is needed. As a result, the connector has to be designed with a view to optimising the connector with regard to performance and cost.

- 5 The interface on the wireless terminal comprises three to five signal pads for interacting with a similar amount of pogo pins 41, which are included in the cover 25.

Pin name	Pin no	A	D	Unit
CTI	1.	4.3	2	mm
V <sub>SS</sub>	2.			
V <sub>DD</sub>	3.			
Data	4.			
Clock	5.			

10 Table 3 - Pin order and pad sizes

The order of the pins appears from fig. 4 and 5. The pins 41 are arranged in a line in equal distance, A. The diameter, D, of the five pads 44 is substantially greater than the diameter 15 of the plungers 42 of the pins 41 in order to ensure a reliable connection.

It shall be noted that the wireless terminal 1 may have five pads 44. If the functional cover does not support the data 20 modes, only three pins 41 are needed, and these three pins 41 engage the pad 44 corresponding to pins no 1-3.

The connector according to the preferred embodiment of the invention comprises three Pogo-pins 41 (spring-loaded contacts) 25 mounted on a rigid Printed Wiring Board 40.

The pogo-pins 41 are mechanically fixed and soldered on the Printed Wiring Board 40 in order to maintain safe and low resistance contact between the phone's main Printed Wiring 30 Board and Functional Cover's small rigid Printed Wiring Board 40. A plunger 42 travel should be at least 1 mm, and the

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pressure force between plunger and main Printed Wiring Board's pads should be minimum 25 g for use in a standard wireless terminal. The pad dimensions and spacing are given in table 4 above.

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Pins may advantageously be gold-plated, and their internal resistance has to be specified according to the application. Preferably the internal resistance does exceed 100 mΩ even after 10,000 cycles.

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Fig. 7 shows the wireless terminal 1 with the front cover 25 lifted. The pads 44 are arranged on the printed wiring board 43 of the terminal. The printed wiring board 43 is covered by a light guide 45 of transparent plastic, which has openings allowing the connector pins 41,42 to access the pads. The connector pins 41,42 are mounted on a printed wiring board 40.

The printed wiring board 40 is mounted on the inner side of the cover 25 by means of snap coupling means 48. On the rear side of the printed wiring board 40 an electric circuitry is provided including e.g. three LED's 47 illuminating respective pipe formed light-guides 49. In the frequency mode an electrical representation of a ringing signal is directed to the electric circuitry for providing an illumination effect following the ringing signal. The light-guides 49 may be illuminated individually in a tempo following the ringing signal. This gives an exciting effect for the user when the functional cover 25 is partly transparent.

30 What is claimed is: -